Vermont: PFAS Into and Out Of Landfills

Kasey Kathan
Solid Waste Management Program,
Vermont Dept. of Environmental Conservation
Thanks:
• Vermont Landfill and Wastewater Treatment Facility Owners and Operators
• Consultants
• Vermont Department of Environmental Conservation Staff
PFAS Impact Monitoring
Public Water Supply Sampling
Surface Water Plan

PFAS in Waste Streams
Landfills
Wastewater Treatment Facilities

Industrial or Intensive Uses
Electroplating
Car Washes
PFAS in Waste Streams - Reports

dec.vermont.gov/pfas

• Evaluation of PFAS within the waste streams disposed of at the New England Waste Services of Vermont (NEWSVT) landfill
  -Sanborn Head: PFAS Waste Source Testing Report, dated October 2019

• Statewide evaluation of PFAS within landfill leachate, wastewater treatment facility (WWTF) influent, effluent, biosolids and sludges
  -Weston and Sampson: Wastewater Facility and Landfill PFAS Sampling Summary report, dated January 2020

• Assessment of treatment options that would reduce or eliminate PFAS within landfill leachate
  -Brown and Caldwell: Conceptual Leachate Treatment Scoping Study for New England Waste Services of Vermont Landfill, dated October 2019
PFAS Going into the Landfill
Bulk analysis of materials being disposed
Bulky Waste and Textiles

Sample Designation Key
F = Furniture
MT = Mattresses
CL = Clothing
OF = Outdoor Furniture
T = Textiles
O = Other
Sludges: Industrial and Municipal

Fig. 1 of 2
Sludges: Industrial and Municipal

Fig. 2 of 2
Contaminated Soils

Sample Designation Key:
- PAH = Polycyclic Aromatics
- PET = Petroleum Hydrocarbons
- PCB = Polychlorinated Biphenyls
- TFR = Tire Fire Residue

The graph shows the concentration of various compounds in different samples. Each sample is labeled with a code (e.g., CSC-1, CSC-2) and the concentration of PAH is highlighted in a specific color. Other compounds such as PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnA, PFDoA, PFTrDA, FTeDA, PFBS, PFPeS, PFHxS, PFHpS, PFOS, N-MeFOSAA, N-EtFOSAA, 4:2 FTS, 6:2 FTS, and 8:2 FTS are also indicated with different colors and concentrations.
Construction and Demolition
(includes carpeting)

Sample Designation Key:
C = Carpeting
R = Roofing
S = Siding
F = Flooring
WC = Wall & Ceiling Material
O = Other
Commercial Wastes

Sample Designation Key
WP = Waterproof Coatings
SC = Surface Coatings
CM = Cosmetics Manufacturing
FP = Food Packaging
W = Wire Manufacturing
CT = Clothing & Textiles
PM = Plastics Manufacturing
CW = Carwash
CP = Coated Paper
E = Electroplating
P = Packaging
IP = Ink Printing
PFAS Loading into the Landfill

Based on:
- concentrations detected; and
- estimates of the tonnage of each waste type disposed
PFAS Coming Out of Landfills
Preliminary Analysis of Leachate

Leachate Concentration Guidelines: October 2017

<table>
<thead>
<tr>
<th>PFAS analyte:</th>
<th>Landfill Leachate concentration requiring no restrictions</th>
<th>Landfill Leachate concentration which may require restrictions</th>
<th>Landfill Leachate concentration requiring pretreatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFOA</td>
<td>0.120 mg/L</td>
<td>0.120 mg/L to 1.2 mg/L</td>
<td>&gt;1.2 mg/L</td>
</tr>
<tr>
<td>PFOS</td>
<td>0.001 mg/L</td>
<td>0.001 mg/L to 0.010 mg/L</td>
<td>&gt;0.010 mg/L</td>
</tr>
</tbody>
</table>

Discharge of leachate through a wastewater treatment facility (with no reduction in concentration) was calculated to achieve Vermont drinking water standards and surface water standards established by other states within the receiving body of water.
## Leachate Results

- Two different analysis methods utilized (MLA 110, modified EPA 537) with comparable results in duplicates
- No leachate sample exceeded guideline concentrations

### MLA 110

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Perfluorooctanoic acid (PFOA)</strong></td>
<td>2,110</td>
<td>2,030</td>
<td>110</td>
<td>379</td>
<td>1,850</td>
</tr>
<tr>
<td><strong>Perfluorooctane sulfonate (PFOS)</strong></td>
<td>278</td>
<td>217</td>
<td>99.1</td>
<td>22.5</td>
<td>244</td>
</tr>
</tbody>
</table>

### Modified EPA Method 537

<table>
<thead>
<tr>
<th></th>
<th>Closed 2013: Cell 1 *</th>
<th>Closed 2013: Cell 2 *</th>
<th>Closed 2013: Cell 3 *</th>
<th>Closed 1995 *</th>
<th>Operating</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perfluorooctanoic acid (PFOA)</strong></td>
<td>1,400</td>
<td>2,800</td>
<td>1,900</td>
<td>418</td>
<td>1,050</td>
</tr>
<tr>
<td><strong>Perfluorooctane sulfonate (PFOS)</strong></td>
<td>250</td>
<td>300</td>
<td>270</td>
<td>ND</td>
<td>110</td>
</tr>
</tbody>
</table>

* denotes a sample that was taken and analyzed independently by the landfill owner and reported to the SWMP.
PFAS Coming Out of Landfills

Analysis of Leachate
PFAS in Wastewater
Analysis of Influent and Effluent at Wastewater Treatment Facilities (WWTF)
Primarily Residential WWTF Averages

- Influent
- Effluent

Graph showing the concentrations of various PFAS compounds in influent and effluent samples.
Evaluation of Leachate Treatment Options

Request: Evaluate available leachate treatment options for PFAS and recommend two on-site and two off-site options

Challenges and Assumptions:
1. No promulgated treatment or discharge standard

2. Research on PFAS treatment predominantly focused on ‘clean’ liquids and PFOA or PFOS – leachate is a complex matrix, requiring pre-filtrations

3. All commercially available treatment options for leachate either concentrate or capture PFAS – residuals must be stabilized or destroyed off-site
Preferred On-Site Options: Direct Discharge to Surface Water

- Raw Leachate: 50,000 gpd
- Existing Leachate Storage Tanks
- RO (Rochem): 40,000 gpd
- GAC
- Remineralization
- Discharge to Surface Water: 40,000 gpd
- RO Concentrate: 10,000 gpd
- LFG
- Leachate Concentrator
- LFG
- Sequestration/Solidification:
  - solids to landfill
  - 2.3 tons/day (Sequestered)
- Thermal Oxidizer
- To Atmosphere
- Water Vapor
- Offsite Regeneration of GAC
Preferred On-Site Options: Zero Liquid Discharge

- Raw Leachate
  - 50,000 gpd
  - Existing Leachate Storage Tanks
  - Leachate Concentrator
    - Waste heat from Engines
    - Thermal Oxidizer
      - To Atmosphere
      - LFG
    - Water Vapor
    - 2,500 gpd
    - Sequestration / Solidification
      - Solids to landfill
        - 11.5 tons/day
        - (Sequestered)
Preferred Off-site Options: 50% reduction Pretreatment at WWTF

Raw Leachate
50,000 gpd

Existing Leachate Storage Tanks

Haul to POTW if POTW Sited

RO (Rochem) 50% Removal

RO Concentrate
5,000 gpd

Haul to NEWSVT if POTW Sited

Leachate Concentrator

Thermal Oxidizer

To Atmosphere

LFG

Water Vapor

250 gpd

Sequestration/Solidification

Solids to landfill
1 ton/day (Sequestered)

Discharge to POTW
43,000 gpd

Leachate concentrator and solids management to be located at NEWSVT in all cases due to LFG availability
Preferred Off-site Options: WWTF Enhancement

- Raw Leachate
- 50,000 gpd
- POTW Flow plus Leachate Flow
- Existing POTW
- Filtration
- GAC
- Discharge to Surface Water
  - POTW plus Leachate Flow
- Backwash 5% of POTW plus Leachate Flow
- Spent GAC for offsite regeneration
PFAS in Waste Streams

1. PFAS detected in nearly all wastes sampled, with large loading likely from residentially source materials. There is no ‘easy’ source of PFAS that can be removed from the waste stream.

2. PFAS detected at all WWTFs, even those not accepting landfill or industrial discharges
   
   but...
   
   PFAS concentrations at WWTFs that accept significant volumes of leachate are elevated.

3. Treatment of leachate for PFAS is feasible using proven technologies
   
   but....
   
   it would come with a cost and still has significant challenges with the management of treatment residuals.
Perfluoroalkyl Substances (PFAS) Statewide Sampling Plan

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Kasey Kathan
kasey.kathan@vermont.gov
(802) 522-0561

dec.vermont.gov/pfas